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AUTHOR	Smithson, J. R.
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ABSTRACT

College sophomores at the United States Naval Academy were homogeneously sectioned in General Physics I and II during the academic year 1968-1969. The better students were selected for General Physics I on the basis of their QPR in their freshman year. The poorer students were selected for the second semester course on the basis of their grades during the first semester. The results were summarized on the basis of objective final examinations: (1) better students do equally well in either homogeneous or heterogeneous sections; and (2) poorer students do better when placed in heterogeneous sections rather than homogeneous sections. Instructors tend to grade daily work more liberally when teaching homogeneous sections of low ability. (Author/TS)

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Two Experiments in Homogeneous Sectioning of Students in General Physics

J. R. Smithson
Unites States Naval Academy

Introduction. Although the education literature is filled with studies of homogeneous vs heterogeneous sectioning of students in elementary and secondary schools, very little has been reported at the college level and the author is not aware of any such studies involving large numbers of college students in physics. In the academic year 1968-1969 we had the opportunity to collect some data on homogeneous sections of both good students and poor students. The courses were General Physics I and II, which at that time were required of all sophomores except majors in physics, applied science, and electrical engineering. Each course consisted of three fifty-minute class periods and one two-hour laboratory period per week for a sixteen-week semester. The textbook was Halliday and Resnick. Enrollment was 994 in General Physics I during the first semester and 925 in General Physics II during the second semester. The students were computer scheduled into twelve divisions each of which had a different class schedule. Each division was then subdivided into sections of 15-20 students. Twenty-five instructors taught one or more of the resulting sections with the same instructor meeting the section for both classes and laboratory.

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Part I - Special Sectioning of Better Students

In the first semester two of our instructors, J. L. Jones and R. C. Bucholz, carried on an experiment[1] in the use of the remote computer terminals for drill problems in General Physics I. It was decided in advance that these problems were not designed to challenge the better students so that in each of the three experimental divisions the upper 20% of the students, based on freshman year QPR, were placed in separate sections which did not use the computer problems. In the nine remaining divisions the sections were formed randomly by QPR.

[1] Results of this experiment were reported in paper C6 at the 38th Meeting of AAPT at New York on 3 February 1969.

At the end of the semester all students took a common examination consisting of 75 objective questions. The examination scores of the 48 students in the three special sections were compared with those of comparable students in the random sections of the other nine divisions. For this comparison the upper 20% of the students, based on freshman year QPR, were selected from the nine divisions. This gave a group of 144 students.

The mean examination scores with the probable errors of the means are given below.

Mean Score of 48 Better Students in Homogeneous Sections.	47.9 $\pm$0.9
Mean Score of 144 Better Students in Heterogeneous Sections.	48.5 $\pm$0.5
Difference of Means	0.6
Probable Error of Difference of Means . . .	1.0

These results show that on the objective examination there is substantially less than a 50% chance of a significant difference in performance of the better students in homogeneous vs hetergeneous sections.

Part II - Special Sectioning of Poorer Students

During the second semester in each of three divisions of General Physics II special sections were formed composed primarily of students with a final grade of D in General Physics I. Because there were only 21 of these students in the three divisions those students with a final grade of C but a lower examination grade were also placed in these sections. This brought the total enrollment of the three sections to 34 or an average of 10.3 per section. Only the 21 students with D for General Physics I are considered in this report. The three sections were taught by three instructors all of whom were experienced instructors in this course. Each of these instructors also taught a regular section of the same course.

In the remaining nine divisions of General Physics II, sectioning was random by QPR. Average section size was 18.6. There were 33 students in these nine divisions who had a final grade of D in General Physics I. In the random sectioning these students were scattered through 20 of the 36 sections in these divisions. In one case four were in one section; in two cases three were in a section; in six cases two were in the same section; and in eleven cases there was one in a section. Fourteen instructors taught the 20 sections; six

experienced and eight who were teaching the course for the first time. Thirteen of the students were taught by experienced instructors and twenty by 'inexperienced' instructors. At the end of the semester all students took a common examination consisting of 75 objective questions.

The mean examination scores with the probable errors of the means are given below.

Mean Score of 21 Poorer Students in Homogeneous Sections	35.5 ± 0.9
Mean Score of 33 Poorer Students in Heterogeneous Sections	37.0 ± 0.9
Difference of Means	1.5
Probable Error of Difference of Means . . .	1.3

These results show that on the objective examination there is better than a 50% chance that the poorer students did significantly better when taught in random sections with better students than when taught in special homogeneous sections. This is true dispite the fact that the homogeneous sections were much smaller and were taught by more experienced instructors.

An interesting fact was discovered when the examination grades of the poorer students were compared with the grades for all class and laboratory work prior to the final examination.

	Homogeneous Sections		*Random Sections*	
	Number	*Percent*	*Number*	*Percent*
Exam Grade Higher	1	4.8	8	24.2
Exam Grade Same	9	42.9	12	36.4
Exam Grade Lower	11	52.3	13	39.4
	21	100.0	33	100.0

Counting one point for each letter grade, the homogeneous groups had examination letter grades which averaged 0.8 points per man less than their classwork and laboratory letter grades. The group in random sections had examination letter grades which averaged 0.3 points less per man than their classwork and laboratory grades. This shows that, while poor students tend generally to get lower examination grades than their grades on daily work, those placed in separate sections show a much more pronounced difference. This indicates that even experienced instructors grade more liberally when teaching special sections of low ability. This *"Santa Claus Effect"* resulted in approximately the same final grade distribution for both groups when examination grades were combined with all other grades to compute final course grades.

Conclusions

On objective final examinations in general college physics:

1. Better students do equally well in either homogeneous or heterogeneous sections;

2. Poorer students do better when placed in heterogeneous sections rather than homogeneous sections.

Instructors tend to grade daily work more liberally when teaching homogeneous sections of low ability.